Memorandum

To: Bill Mahley

From: Michael Pisani, P.E.

Date: June 5, 2017

Re: Technical Memorandum
Delta Shipyard NPL Site Constituents
Houma, Louisiana

The purpose of this technical memorandum is to address your question concerning the reported detections of lead, cadmium, and PCBs in the open pit area at the Delta Shipyard site as relates to past disposal of drilling mud at the site.

Background

The Delta Shipyard site is located in Houma, Louisiana, and was listed on the Superfund National Priorities List (NPL) by EPA in September 2014. The basis of the listing is contained within the EPA's Hazard Ranking Score (HRS) package and documents referenced therein. The site was scored and listed on the basis of the surface water pathway. The hazardous constituents considered in the scoring (Scoring Hazardous Substances) are as follows:

Anthracene
Antimony
Arsenic
Benzene
Cadmium
Chromium
Ethylbenzene
Fluorene
Lead
Manganese
Mercury
2-methyl-naphthalene
Naphthalene
Phenanthrene
Pyrene
O-xylene
M-xylene
P-xylene
Zinc

The site description in the HRS package describes the open pits as having been used for disposal and evaporation of waste and cleaning water from the cleaning of barges/vessels prior to repairs at the shipyard.

You have reported that you or others conducted interviews of people knowledgeable of the site. These knowledgeable people have reported that the pit area that was/is the subject of the EPA sampling, HRS scoring, and NPL listing was used for the disposal of oilfield drilling muds. The waste management area for the barge/vessel cleaning was remote from the pit area and not interconnected to the pit area. The waste management area for the barge/vessel cleaning was closed under Louisiana Department of Environmental Quality (LDEQ) directive/authority in the mid- to late-1980s.

The remote nature and separation of the barge/vessel cleaning waste management area from the HRS pit area is confirmed in Figure 3-1 of the Weston ARCS Expanded Site Inspection report (a distance of approximately 1,000 feet between facilities). The point of discharge and flow path for wastewater from the barge/vessel cleaning area is documented in a *Wash Waste Treatment Facility* diagram attached to the March 11, 1981 *EPA Preliminary Assessment report for Delta Shipyard*. There is no communication or communication potential via the surface water pathway between the two facilities.

You have reported that the question has been raised that if the open pit area was used only for disposal of spent drilling fluids, why does the waste contain the constituents lead, cadmium, and PCBs. As discussed below, whether PCBs are present is debatable as results were unable to be duplicated. PCBs are not a basis for the NPL listing. As for the constituents that were cited in the listing, all are consistent with oilfield drilling muds.

Metals

Oilfield waste, including drilling fluids, are known to contain elevated concentrations of metals, including the following Scoring Hazardous Substances: arsenic, cadmium, chromium, lead, mercury, zinc, antimony, and manganese. See Louisiana's Statewide Order 29-B, Neff[1], Science Applications, Inc.[2], Duke[3], and Neff[4].

Neff[1,4], working on behalf of EPA, documents the ranges of lead, cadmium, and other Scoring Hazardous Substance metals in drilling mud. The documented range of lead in drilling mud is 0.4 to 4,226 mg/kg[1,4]. The documented range of cadmium in drilling mud is 0.16 to 54.4 mg/kg[1,4].

The concentration of lead reported in pit samples from the Delta Shipyard site ranged

[1] Neff, J. M. 1982. Fate and Biological Effects of Oil Well Drilling Fluids in the Marine Environment. A Literature Review. EPA-600 (53-82-064).

[2] Science Applications, Inc. *Drilling Mud Assessment Chemical Analysis Reference Volume*, EPA-600/3-84-048; March 1984.

[3] Duke, T., Parrish, P. *Results of the Drilling Fluids Research Program Sponsored by the Gulf Breeze Environmental Research Laboratory, 1976-1984, and Their Application to Hazard Assessment*, EPA-600/4-84-055, June 1984.

[4] Neff, J. M. *Composition, Environmental Fates, and Biological Effects of Water Based Drilling Muds and Cuttings Discharged to the Marine Environment: A Synthesis and Annotated Bibliography*; Prepared for the Petroleum Environmental Research Forum (PERF) and American Petroleum Institute; January 2005.

from less than 100 mg/kg to a maximum of 2,170 mg/kg. Only two of 108 samples analyzed exceeded 1,000 mg/kg. These reported concentrations are well within and to the lower end of the range reported for drilling mud by Neff[1,4].

The concentration of cadmium reported in pit samples from the Delta Shipyard site ranged from less than the detection limit to 18.3 mg/kg. Only two of 108 samples analyzed exceeded 10 mg/kg. These reported concentrations are well within and to the lower end of the range reported for drilling mud by Neff (1982)[1,4].

Conclusion

The presence of elevated (above background) concentrations of metals, including the Scoring Hazardous Substance metals, are expected in drilling mud specifically and in oilfield waste in general. All reported results for the metals, including lead and cadmium, were well within and to the lower end of expectations for drilling mud.

Remainder of Scoring Hazardous Substances

The remaining Scoring Hazardous Substances are organic compounds. Oil-based drilling muds from the mid-1980s and earlier contained these same organic compounds because the mud was a mixture of diesel fuel, clays, weighting agents, and additives[1,2,3,4]. The diesel fuel contains the organic compounds[1,2,3,4]. In addition, both oil-based used muds and water-based used muds can entrain these same organic compounds from the formation fluids (oil, gas, and condensate)[4]. The presence and concentration ranges of these compounds in drilling muds is well documented in the literature.[1,2,3,4,5,6,7,8,9,10]

PCBs

PCB concentrations were reported but not evaluated and were not a basis for the listing of the site.

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[5] Okparanma, R. (2010) Polycyclic Aromatic Hydrocarbons in Nigerian Oil-Based Drill-Cuttings; Evidence of Petrogenic and Pyrogenic Effects, available at http://www.idosi.org/wasj/wasj11(4)/3.pdf

[6] Wills, J. (2000) A Survey of Offshore Oilfield Drilling Wastes and Disposal Techniques to Reduce the Ecological Impact of Sea Dumping, available at http://www.offshore-environment.com/additives.html

[7] Ashraf Y. (2014) Extraction and Chromatographic Analysis of Gases Dissolved in Water Base Mud

[8] Okparanma; Jagwani D., (2011) PAH Composition of Water Based Drilling Mud and Drill Cuttings in the Offshore Region, East Coast of India, available at https://link.springer.com/article/10.1007/s00128-011-0340-x?no-access=true

[9] McFarland, M. (2009) Land Application of Drilling Fluids: Landowner Considerations, available at http://soiltesting.tamu.edu/publications/SCS-2009-08.pdf

[10] Adekunle, I. M., Igbuku, O. O., Oguns, O.; Shekwolo, P. D. *Emerging Trend in Natural Resource Utilization for Bioremediation of Oil-Based Drilling Wastes in Nigeria*; published in *Biodegradation Engineering and Technology;* http://dx.doi.org/10.5772/56526; 2013.

The PCB Arochlor 1260, Arochlor 1254, and Arochlor 1016 were analyzed in many samples and most were non-detect. Where detected, the concentrations were at or near the reporting limits and were often flagged with a laboratory qualifier indicating uncertainty with the analyses. PCBs are difficult to analyze and accurately quantify in an oily waste matrix such as exists at this site.

There were two pit samples with concentrations well above the detection limit but substantially less than any risk based level or typical cleanup level. The reported concentrations for Arochlor 1254 for these two samples (DSE 02 and DSE 03) were 0.114 and 0.259 mg/kg, respectively, as compared to the EPA risk based standard of 3.4 mg/kg for residential soil and 32 mg/kg for industrial soil. These results were not duplicated when EPA collected depth discrete samples from the open pit area. The three times background value posted by EPA for Arochlor 1254 ranged from 0.156 to 0.231 mg/kg.

PCBs were not detected during the pit sampling conducted by EPA in 1994.

PCBs are relatively ubiquitous in the environment because of the large mass manufactured and the long-term persistence of the chemical in the environment. PCBs are documented to be present within the ice layers of the Artic[11].

Conclusion

PCBs were not a basis for the listing of the site and their actual/true presence at the site is uncertain because of laboratory qualifiers, the potential for matrix interferences in the laboratory analyses, and the lack of duplicated results. Two potentially elevated (but less than risk based standards) results were not duplicated when EPA sampled the open pits on a depth discrete basis and were not present during earlier sampling at the site.

[11] NOAA; *Ocean Facts*; *What are PCBs*; available at http://oceanservice.noaa.gov/facts/pcbs.html; revised March 2014.